

Fig. 7. Spicula of *C. celata*.

Fig. 8. A few of the cells of *Orbitoides Fosteri*, from Dr. Carpenter's figure, after Ehrenberg; *a*, cell next primordial cell; *b, b*, stolons or stems uniting the cells.

Fig. 9. A portion of an undescribed *Cliona* immersed in the shell of *Pecten Magellanicus*: *a, a*, lobes of the sponge corresponding to the cells in fig. 8; *b, b*, stolons or stems.

PLATE VIII.

Fig. 1. Spicula of *Cliona Mazatlanensis*: *a*, pin-like spicula; *b*, fusiform ditto; *c, c*, minute or third form of ditto.

Fig. 2. Spicula of *C. vermifera*: *a*, pin-like spicula; *b, b*, the second or worm-like ditto.

Fig. 3. Ditto of *C. globulifera*.

Fig. 4. Ditto of *C. Carpenteri*: *a, a*, pin-like spicula; *b*, fusiform ditto; *c, c*, the third or minute form of ditto.

XXXVII.—On the Young Stages of a few Annelids.

By ALEXANDER AGASSIZ.

[Concluded from p. 218.]

POLYDORA, Bosc (*Leucodora*, Johnst.).

Claparède having given, in his 'Beobachtungen,' a very complete history of the development of what he calls *Leucodora ciliata*, the following observations would be superfluous as far as they relate to new phases in *Polydora*, but may be useful in clearing up the confusion existing concerning the identity of *Leucodora*, Johnst., and *Polydora*, Bosc. Quatrefages, in his Synoptic Table*, has introduced these two genera as distinct, and separates them on account of the remarkable structure of the bristles of the fifth ring in *Polydora*, which he says is not to be found in *Leucodora*: this must evidently be a mistake, as Johnston's figure† certainly possesses the peculiar bristles of the fifth ring, as maintained by Claparède in his 'Beobachtungen.' Yet, notwithstanding this correction of Quatrefages by Claparède‡, in his review of the system proposed by the former, and the accurate description given by him (Claparède), in Müller's 'Archiv'§, of *Polydora cornuta*, we find him associating with the genus *Polydora*, in his embryology of *Leucodora ciliata*, a genus which is certainly not *Polydora* as he himself has limited it, but may be a species of *Spio* or *Nerine*, or per-

* "Note sur la Classification des Annelides," in Comptes Rendus, 27 March, 1865 (Annals, ser. 3. vol. xvii. pp. 1, 107).

† "Miscellanea Zoologica," in Mag. Zool. Bot. 1838, ii. p. 66.

‡ Bibliothèque universelle de Genève, Avril 1865. [Annals, ser. 3. vol. xvii. p. 100.]

§ "Ueber *Polydora cornuta*, Bosc," in Archiv für Anat. u. Phys. 1861 p. 542.

haps what Quatrefages understands by *Leucodora*. At any rate it is self-evident, from the following embryology of a species of true *Polydora*, and of a species of what Claparède has called *Leucodora* in his 'Beobachtungen,' that we have in each, developed at a very early period, genuine characters which refer undoubtedly one form to *Polydora* and the other to a different genus (*Leucodora*, Clap., non Johnst.), probably *Nerine*, Johnst.—thus proving the assertion of Quatrefages* of the generic difference between *Leucodora*, Clap., and *Polydora*, Bosc. And yet, in spite of this generic difference, Claparède was correct in maintaining the identity of *Leucodora*, Johnst., and *Polydora*, Bosc, as can readily be seen on examining the descriptions and figures of Bosc†, Johnston, Oersted‡, Leuckart§, Claparède, and Kefenstein||. The error arises from Claparède's mistaking for the young of *Polydora* the young Annelids figured by him on pl. 7 of his 'Beobachtungen,' which, having no trace of the characteristic fifth segment, belong therefore not to *Polydora*, Bosc, but to some closely allied genus, as suggested above. It is not probable that such an accurate observer as Claparède would have overlooked this segment, so prominent in the youngest specimens of our *Polydora*, as well as the presence of the glands, so early developed in the young worm, and which he noticed in his description of the adult in Müller's 'Archiv.' In my earlier observations I made a similar mistake between the young of *Polydora* and *Nerine*; and it was not till the striking difference of the fifth ring and the presence of glands were noticed that I could afterwards always readily distinguish the young of these two genera, so easily mistaken at first sight.

I shall introduce a few of the stages of *Nerine*, with a short description of the adult, for the sake of comparing them with the different stages of *Polydora*, which will be given more in detail, and of identifying them, as far as possible, with those observed by Claparède. It is apparent at the first glance, on comparing his drawings of *Leucodora* with those here given of *Nerine* and *Polydora*, that they represent closely allied genera; but, as similar young stages of other genera have also been figured by Leuckart and Pagenstecher as *Spio*, as well as by

* "Note sur la Classification des Annelides, et réponse aux observations de M. Claparède," in Ann. des Sc. Nat. 5^e ser. iii. 1865 (Annals, ser. 3. vol. xvii. p. 107).

† Histoire Naturelle des Vers.

‡ "Zur Classification der Anneliden," in Archiv für Naturg. 1844, i. p. 105.

§ "Zur Kenntniss der Fauna von Island," in Archiv f. Naturg. 1849, i. p. 200.

|| "Untersuchungen über niedere Seethiere," in Zeits. f. wiss. Zool. xii. p. 116, June 1862.

Busch and by Frey and Leuckart*, the adults of which are not known, we must be exceedingly careful in our identifications of apparently closely related forms, and give these identifications more as hints for future observers than as positive statements.

The young of *Polydora* and *Nerine*, like the young of *Leucodora*, Claparède, are kept in confinement with the greatest ease; hence the possibility of tracing the changes of growth in a connected manner until they have assumed unmistakably the features and habits of the adult, and built their cases on the bottom of the jars where they are confined. The youngest stages observed (Pl. V. fig. 26) are considerably more advanced than those of Claparède, having already lost, if they ever possessed them, the bunches of ringed bristles so characteristic of the younger stages of many Annelids, such as *Leucodora*, Clap., *Nerine*, and *Spio*. The tentacles of the head are developing; and there remain but slight traces round the head and anus of the former rings of vibratile cilia, as well as very narrow bands of short vibratile cilia on the dorsal side; similar bands are found on the lower side, composed of larger cilia, which greatly assist in locomotion. These bands are less powerful towards the extremities, being greatly developed towards the middle, especially on the lower side. The vibratile ring surrounding the anus is less prominent than in Claparède's embryo; the anterior and posterior rings of cilia, as well as the transverse bands, diminish rapidly in size with advancing age, so much so that in fig. 28 they have almost totally disappeared. In the youngest stage seen (fig. 26) there are four well-developed anterior rings, each provided with an upper and lower bunch of bristles, the dorsal bunches being the longest, and diminishing in length as they recede from the head, the lower bunches consisting of bristles all of the same length; the fifth ring (r_5) is much wider than any other, and has only three short, stout bristles on each side; then comes the sixth ring, each side having a bundle of bristles similar to those of the smaller cluster of the four anterior rings; in the subsequent rings, which are nearly equally developed, having a slight lateral swelling and rudimentary dorsal cirrus, we find a similar bundle of bristles, and, in addition, in the seventh, eighth, and ninth, a single hook-shaped bristle; while immediately in front of the anal extremity the rudimentary rings have merely a couple of thin bristles. The three rings following the sixth have rudimentary glands (*g*), first observed in this genus by Claparède in his description of *Polydora*; they consist, however, of a smaller number of glands, only two or three in each bag. The general colour of *Polydora* at this period

* 'Beiträge zur Kenntniss wirbelloser Thiere' (Braunschweig, 1847), pl. 1. fig. 19, p. 98.

is quite a delicate grey, of a yellowish tinge, with a bright yellow line along the middle of the back and following the outline of the head; this is rendered more brilliant by its contrast with the black pigment-spots which are well developed on the head and first ring and attain their greatest prominence on the sixth, seventh, and eighth, gradually diminishing to a few isolated dots near the anus. On the head it is almost impossible to distinguish the eyes proper from the pigment-spots; it is, however, evident that the eyes are more numerous in the young than in the adult, which is the case with many other Annelids, as observed by Milne-Edwards, Agassiz, and Claparède. The identity of the pigment-spots and eyes has been suggested by Claparède, who could discover no difference between them; and we have, perhaps, in the pigment-spots scattered over the whole surface of the body something analogous to the presence of eyes in *Fabricia* at the anal extremity. The distribution of the pigment-spots in *Polydora* is quite different from that in *Leucodora*, and from that observed by Claparède and by myself in *Nerine*: in the latter they are more abundant and intense in the anterior extremity; while in *Polydora* they take their maximum development from the middle of the body towards the posterior part, leaving the anterior extremity, with the exception of the head, nearly colourless.

The mouth opens, by a longitudinal slit formed by the thickening of the lips, into an ill-defined œsophagus which extends to the fifth ring and then opens into a digestive cavity terminating at the anus and not yet divided into a true stomach and intestine.

In the next stage (fig. 27) we find no material change in the anterior part, with the exception of the slight increase in length of the tentacles, the diminution in number of the pigment-spots round the eyes, and their increase on the four anterior rings. The posterior part has considerably increased in size, a number of additional rings having been formed in front of the anal ring; the pigment-spots are now arranged in two regular rows; the dorsal cirri have not increased in size; but we find in the seventh and succeeding rings, at the base of the bunch of thin bristles, two hook-shaped bristles instead of one; the œsophagus is more clearly marked than in the preceding stage; the glands are found in all the rings except the last. In the following stage (fig. 28) there has been a still further growth of the tentacles, and we find the pigment-spots arranged both above and below in four parallel rows, the outer rows being the smaller and less prominent. There are now four hook-shaped bristles at the base of each of the dorsal cirri, which are readily recognized as such in the rings immediately

following the seventh. The bunches of long bristles of the four anterior rings are gradually losing their prominence, becoming less numerous in the present stage, and are replaced by bristles similar to those of the other bunch. At this period the number of rings does not increase rapidly; the principal changes are confined to the growth of the dorsal cirri and of the tentacles, as well as to changes in the pigment-spots. When examined in somewhat more advanced stages (fig. 29), from the lower side, we still have the pigment-spots prominent and well marked; the only change consists in the lengthening of the tentacles and the dorsal cirri, which are both fringed on their anterior edge by vibratile cilia.

On examining a young *Polydora* from the dorsal side, somewhat more advanced (fig. 30), still having the same number of segments in front of the anal ring, we find the four lines of brilliant star-shaped pigment-spots diminished to four rows of dots; the body has grown somewhat opaque and assumed a reddish tinge, especially along the alimentary canal. At about this period, also, the young begin to build their case, secreting a copious viscid fluid (from the glands at the base of the dorsal cirri?), to which particles of sand and mud become attached as they creep along the bottom; although they frequently leave this case, they no longer possess the great power of locomotion of the young larvæ (figs. 26-28), which moved about rapidly by means of their rows of vibratile cilia and bunches of long bristles. The pigment-spots of the head have disappeared, except four prominent eye-specks,—the same number as found in the adult, in which, however, they are far less conspicuous than in this stage of the young.

When the young worm has already thirty-five rings, there have been no changes of any consequence besides the further lengthening of the dorsal cirri and the increase of the rudimentary cirrus at their base, which can first be traced in fig. 29; two small tentacles have been formed at the anterior part of the head (Pl. VI. fig. 31). The number of bristles of the fifth ring has increased to five, and the number of glands in each envelope to eight or ten. In nearly full-grown specimens, when seen from below, these glands are particularly prominent (fig. 32), as well as the six hook-shaped bristles at the base of the short cirrus. The black pigment-dots have all disappeared, and the worm is gradually assuming a darker tinge; the fifth ring has increased in width, the larger of its bristles assuming the shape they have in the adult, as in fig. 37, with a slight notch at their swollen exterior extremity. The simple hook-shaped bristles of the seventh and succeeding rings have developed a slight process on the convex side, with a stiff bristle (fig. 38) extending from

the base of the curve, as in the adult *Polydora*. The anal ring has taken a somewhat funnel-shaped form, with which the little worms can attach themselves quite firmly; this anal disk (fig. 34) is made use of by the adult almost as freely as the sucking-disk of a leech.

In the adult (fig. 33) the dorsal cirri equal in length the thickness of the body, and have lost their vibratile fringe; the glands have taken a great development, consisting of no less than from thirty to forty comma-shaped bags packed closely together within one envelope, as in fig. 36. The digestive cavity has undergone slight changes; the œsophagus has remained as in previous stages, but we have a short intestine into which the long stomach empties. When seen from above, the head is pointed; seen in profile, it projects in a quadrangular flap, and shows the rudimentary tentacles formed at the base of the larger ones (fig. 35). The eyes are small, four in number; the fifth ring has nine stiff bristles in different stages of growth; their number, however, is not limited, as we always find small ones growing even in the oldest specimens. Their use seems to be, as far as I can ascertain, to assist the worm in retreating into its case when disturbed.

The adult worms are found between high- and low-water mark, about half-tide; they abound in places where there is a mixture of sand and mud, building their cases upright, in large colonies, closely crowded together. The younger stages (figs. 26–28) were always caught in great numbers with the dip-net, the more advanced stages being raised from them in captivity. Their growth is very rapid, as in less than six weeks they pass from the stage of fig. 28 to that of fig. 32.

The species here described is probably the same as the *Polydora* found by Claparède on the coast of Scotland; it is not the species called *Polydora cornuta* by Bose, which occurs plentifully in sand and mud-flats on Sullivan's Island, in the harbour of Charleston, S. C. The South Carolina species differs from its northern representative by the length of its head, its short antennæ, and greater size. Our species seems closely allied to, if not identical with, *Polydora ciliatum*, Clap. (*Leucodora ciliatum*, Johnst., Kef.).

NERINE, Johnst.

The youngest stages of this species of *Nerine* (fig. 39) resemble young Annelids figured previously by Busch* and by Leuckart and Pagenstecher†, and referred by them to the closely

* Beobachtungen, pl. 7. fig. 5.

† "Die Entwicklung von *Spio*," in Archiv f. Anat. u. Phys. 1858, p. 610, pl. 23. fig. 4.

allied, if not identical, genus *Spio*. We find in both the large brushes of stiff, serrated, temporary bristles observed by Claparède in his young *Leucodora*, which, at the least disturbance, they spread fan-like in every direction, roll themselves up into a ball like a hedgehog, and become quite motionless, but soon start off again on their rapid gyrations, performed by means of an exceedingly powerful circle of vibratile cilia surrounding the head. The body at this early stage consists of seven distinct rings, and faint indications of a couple more in front of the anal ring, also surrounded by strong vibratile cilia. The dorsal cirri are slight swellings, and at the base of each we find two brushes of permanent bristles—the one composed of serrated, file-like, rough bristles (fig. 42^a), similar to those observed by Claparède in an unknown Annelid larva*, the other of smooth setæ, like those of the adult, placed immediately at the base of the rudimentary dorsal cirrus. The œsophagus and stomach are separated by a slight constriction. The younger stages (fig. 39) have no pigment-cells, and are moderately transparent; there are six eyes, the two larger ones, placed nearer the sides of the body, soon disappearing.

In subsequent stages the body lengthens and becomes more pointed; pigment-spots appear near the head, extending towards the anal ring; they resemble those of *Polydora*, pass through the same stages, and, before they disappear, have lost their beautiful star-shaped form, making a double row of more or less rectangular spots, as in fig. 40. The changes have been principally in proportions; the tentacles have slightly developed, the large anterior brush of serrated bristles losing its prominence. The dorsal cirri, as well as the tentacles, now develop rapidly, the powerful circle of vibratile cilia round the head having nearly disappeared (fig. 41). We find in some of the rings of the anterior part of the body the first appearance of the clusters of stiff hook-shaped bristles, like those of fig. 44, found with the lower brush of smooth bristles in the adult; the eyes are four in number, quite small; the pigment-spots have disappeared, as well as the anterior brush of temporary bristles. The little worm now enters a stage when it rapidly assumes the appearance of the adult. The number of rings increases rapidly; the dorsal cirri, as well as the tentacles, lengthen materially; the stomach proper becomes much narrower, and towards the anal extremity a distinct intestine (fig. 42) has been formed. In a stage preceding (fig. 40) it has many characteristics of the larva figured by Busch, on plate 8. figs. 1 & 2 of his 'Beobachtungen.' The serrated bristles

* Beobachtungen, pl. 6. fig. 6.

of these young worms are not lost (as in other Annelids, where the ringed bristles are always temporary), but remain to form in the adult a brush of long bristles on the posterior side of the dorsal cirri (see fig. 43). With the lower bunch of smooth setæ we find the row of hook-shaped bristles first noticed in fig. 41; in fig. 42 we have already from five to six of these bristles at the anterior rings. The upper brush of serrated bristles is found in specimens measuring no less than 4 inches in length, not raised in confinement, but collected on the beach, where they are found in company with *Polydora*, but by no means so common. Along the middle of each ring, on the dorsal side of the younger stages (figs. 39, 40), we find a row of short vibratile cilia; similar rows, less numerous, of larger cilia occur on the lower side. The anal ring terminates, in the adult, in a simple opening with slightly corrugated edges (fig. 45).

The general mode of development is so similar to that of *Leucodora* given by Claparède, and of *Polydora* as figured in the present paper, that only those stages have been introduced which tended to elucidate the comparison with figures previously published resembling them. The resemblance between the young larvæ certainly warrants the affinity between *Nerine*, *Spio*, and *Polydora*, suggested by Claparède (who places them with the Ariciæ), and does not justify us in associating the former with other families, as has been done by Quatrefages in his Systematic Table, and thus bringing them in close relationship with groups having a totally different embryonic development, such as *Phyllodoce* and *Nereis*. The species of *Nerine* here investigated is probably the *Nerine coniocephala* of Johnston*.

Phyllodoce maculata, Oersted†.

Max Müller is thus far the only one who has observed larvæ of *Phyllodoce*‡; from his description they must have been in a condition nearly identical with the oldest larvæ here represented (fig. 52). The youngest stages (figs. 46, 47) have a slight resemblance to the larvæ of *Polynoë* figured by Sars§, Max Müller||, and Claparède¶. We find in these earlier stages a very powerful ring of vibratile cilia extending round the middle of the anterior part of the animal, but no trace of cilia

* Mag. Zool. and Bot. 1838, ii. pl. 2. figs. 9-13, p. 70.

† Grönlands Annulata dorsibranchiata, 1843, pl. 3. fig. 46, p. 39.

‡ Note on p. 17, in Archiv f. Anat. u. Phys. 1855.

§ "Zur Entwicklung der Anneliden," in Archiv f. Nat. 1845, i. p. 11, pl. 1. fig. 12.

|| "Ueber die Entwicklung u. Metamorphose der Polynoën," in Archiv f. Anat. u. Phys. 1851, p. 223, pl. 13.

¶ Beobachtungen, pl. 8. figs. 7, 8.

round the anal extremity. There are two very prominent eyes placed near the anterior extremity, and two quite rudimentary tentacles. There is as yet no exterior communication from the digestive cavity, which is simply blocked out, occupying little more than two-thirds of the space in front of the vibratile ring and of the large shield extending behind it: when seen in profile (fig. 47, upper figure), the cavity is somewhat retort-shaped, and occupies mainly the dorsal portion of the embryo. Immediately behind the shield (fig. 46), we find the small conical body, where we can already trace the first indications of the broad paddles of *Phyllodoce* as delicate transverse swellings on each side, connected by slight articulating lines. The articulations are tolerably distinct when seen in profile (fig. 47, upper figure); from this point of view the embryo appears far from cylindrical; the head is quite rectangular, with rounded corners, and nearly as large as the rest of the embryo. The shield bulges out nearly to the anal extremity, where it suddenly terminates and leaves exposed the small rings preceding the anal ring; this terminal ring has not the prominence so characteristic of other Annelid embryos. On the lower side, immediately behind the vibratile ring, we find a slight swelling towards which the digestive cavity points, and where the mouth eventually is formed (fig. 50), while the rudimentary paddles of the rings are plainly visible along the sides. The motion of these larvæ, as can be readily imagined from the size of the cilia, is exceedingly rapid; and though occasionally at rest for a short time, their gyrations are most unfavourable for careful observations.

In subsequent stages we find that the posterior part, as in nearly all young Annelids, undergoes the greatest changes. The head has retained its shape, and its appendages have not enlarged. The shield and the body have both lengthened (fig. 47, lower fig.); the rings of the young worm are quite distinct, the broad flap (the future paddle) is more prominent; small cirri are developed, from which push out a single rather stiff bristle and two smaller jointed ones. Two small anal cirri have grown at the extremity of the anal ring; on each side of the anterior end of the shield we find two long tentacles, of different sizes (the first pair of tentacles of the adult), the dorsal one being the longest. When viewed in profile (fig. 50), the mouth is seen as a large rectangular opening (fig. 49), placed within the edge of the shield, which extends on the lower as well as the upper surface, though only as a narrow band on the ventral one, without covering any of the rings. The body behind the shield is fully as prominent as the remainder of the embryo, and the broad oars of the rings show undoubtedly that we have

to deal with a *Phyllodoce*. A second pair of small anterior tentacles is budding at the base of the first. Though the digestive cavity opens externally at the mouth and anus, there is as yet no trace of a division into œsophagus, stomach, and intestine; the main cavity still extends from the eye-specks and trends towards the anal opening, gradually diminishing in size. The chord of vibratile cilia have lost none of their power; and it is quite remarkable how long these embryonic features remain, even after the generic characters have become well developed, and how early we can distinguish the family to which our larva belongs. This is even more remarkable in *Polynoë*, where before the young has more than six rings it is already a complete picture of the adult; the same is the case in young of *Nereidæ* described by Milne-Edwards* and Claparède†, the young worm of not more than four rings possessing already all the generic features of the adult.

These young larvæ thrive readily in confinement; they grow rapidly, passing in about ten days from the stage of fig. 46 to that of fig. 50. Subsequently the increase is somewhat slower, and it requires about four weeks longer to find the young *Phyllodoce* so far advanced that we can unmistakably refer it to its proper species. In the next stage (fig. 51) the head and shield begin to lose the prominence they formerly held, the two large tentacles lengthen considerably, and two additional ones are formed on each side, thus making eight long tentacles on the two sides of the now small rounded shield; the anterior tentacles become also somewhat more prominent, as well as the lateral cirri, from which project the bristles, each bundle being composed of four or five besides the aciculum. In a somewhat more advanced stage (fig. 52), having twenty-five rings, we find the anal cirri slightly lengthened, the broad lateral flappers are very distinct, the small lateral cirri assuming nearly the shape they retain in the adult. The head has also become shortened, the two pairs of anterior antennæ are equally developed, and the shield is reduced to a small circular patch. The changes henceforth are limited to the head, to the increase of the broad flappers and anal cirri, and to the different degrees of development of the antennæ, placed, in the stage of fig. 52, directly one behind the other, although at the outset they originate one beneath the other; there is no trace to be seen of the rings corresponding to these antennæ, as we should expect theoretically. They lose little by little the ring of vibratile cilia; the head elongates; the eyes are brought nearer the base of the antennæ, until finally the anterior part of

* Ann. Scien. Nat. 1845, iii. p. 167, pl. 10. fig. 57.

† Beobachtungen, pl. 12.

the little *Phyllodoce* has the shape of fig. 53, and the broad flappers resemble fig. 54, while the anal cirri have nearly assumed the shape of fig. 55.

From the earliest stages, the larva is never very transparent; it is distinctly tinged with brown, becoming darker with advancing age, till, in the stage of fig. 52, marked spots darker than the main colour appear on the median line, which gives these young Annelids such an unmistakeable resemblance to an adult *Phyllodoce* well known to me, and which I had always identified as *Phyllodoce maculata*, Oerst., that I scarcely needed the additional proof of raising these young to the full-grown *Phyllodoce* to convince myself of their identity.

On the Types of Development in Annelids.

Several attempts have been made to classify the larvæ of Annelids. Busch*, Müller†, Schultze‡, and Claparède§ have endeavoured to reduce the forms observed to a few general types. Claparède has fully demonstrated that neither the classification of Busch, Müller, nor Schultze will satisfy the facts thus far observed; and it seems probable that Claparède's classification must share the same fate: we should only remember that all these attempts are based upon such few and incomplete observations that we cannot expect them to apply to subsequent discoveries. The features used by Claparède to form his subdivisions seem somewhat objectionable, as it would be impossible, unless the complete development of the larva were known, to ascertain to which of his divisions they belong; and yet these characters are, as far as the development of Annelids is now known, the best that have been proposed. The presence of temporary bristles is a good criterion for one division, and appears to be connected with fundamental differences in the larvæ, though the other division, based upon their absence, is liable to the usual objections to characteristics derived from negative features alone. How much more remains to be done before any such classification of the Annelid larvæ can be attempted with the least chance of success is best shown by examining in any tabular view the number of families of which we know nothing as yet of their embryonic conditions. And though (since the time of the first papers by Lovén, Sars, Milne-Edwards,

* Beobachtungen, p. 55.

† "Ueber die Jugendzustände einiger Seethiere," in Monatsb. d. Akad. der Wiss. zu Berlin, 1851, p. 422.

‡ "Ueber die Entwicklung von *Arenicola piscatorum*, nebst Bemerkungen über die Entwicklung anderer Kiemenwürmer," in Abhand. Nat. Ges. zu Halle, iii. 1855, p. 213.

§ Beobachtungen, p. 84.

Quatrefages, and Müller) Krohn, Max Müller, Van Beneden, Wagener, Schneider, Keferstein, Pagenstecher, and others, but more especially Claparède, have lately done so much to advance our knowledge of the development of Annelids, we can hardly be said to have more than commenced the investigation of the development of the Annelids proper, which in this respect are far behind the intestinal worms; and we must wait for further observations before classifications of embryonic Annelids can be of material advantage for systematic studies.

Among the young Annelids not yet traced to their adult condition, I would figure two forms totally unlike any hitherto described. They both come in the group of *Metachætæ* of Claparède; and though I cannot refer them to their minor subdivisions, they already show most remarkable features. One of them (fig. 56) reminds us somewhat of *Polydora*, on account of the shape of its head and tentacles; it has, however, already a distinct œsophagus, stomach, and intestine, and not the slightest trace of bristles along the sides of the distinctly articulate body. We find on the anterior extremity, on each side, immediately behind the tentacles an immense cluster of long, smooth setæ, seven to eight in each pencil, nearly twice as long as the young worm. The posterior ring is edged with vibratile cilia, and terminates in a club-shaped appendage. The eyes are distinct, two in number. This little worm ($\frac{1}{30}$ inch in length) I have frequently fished up, throughout the summer, with the dip-net, but, unfortunately, always in the same stage. We have perhaps here again a case similar to that of Lovén's larva, described above, of a young worm, having articulations and well-developed appendages, which has reached a condition when, in other Annelids, the temporary bristles have vanished, the permanent ones replacing them, and in which we find as yet nothing to tell us to what genus our larva may belong. Were I to be guided by analogy (especially on account of the perfect differentiation of the stomach, œsophagus, and intestine, which are always divided late in the larval condition in other Annelids, long after the generic characters have appeared), I should be strongly tempted to consider it the embryo of the young worm represented in figure 57. This would involve a case of retrograde development so much more remarkable than the one described above in the *Nareda*-like worm, that it seems scarcely possible. The number of rings is also different, yet the general aspect of the head, and particularly the lightning-speed of the larvæ, darting off like a shot from perfect rest, are points of great similarity; and I give this suggestion for what it may be worth. The changes to be undergone are of the same nature as in *Nareda*: the tentacles must disappear, the temporary bristles

drop off, and the articulations become less numerous and eventually be lost, as in the adult Nemerteans.

Another young worm, equally striking, is represented in figure 58: it is a parasitic Annelid, attached by its posterior extremity to the underside of the carapace of lobsters, measures about $\frac{1}{30}$ inch in length, and consists of numerous rings. The mouth is edged by a series of small hooks. On the two sides of the anterior part we find three large temporary (?) articulate bristles, four or five times as long as the width of the body; the middle bristle is the longest; next come eight rings without appendages of any sort; the succeeding three rings are each provided with a long bristle, similar to those of the anterior extremity: these are the only appendages of the Annelid, the numerous rings of the body being bare. The anal extremity is somewhat club-shaped. The digestive cavity was not as yet subdivided into separate regions; and nothing in this young worm, in spite of the great number of rings, indicated even the family to which it might belong.

Although the embryological data at our command will not suffice in guiding us to any valuable systematic conclusions, yet the presence of temporary bristles of huge size in the young of so many Annelids is a feature of the greatest interest from a palæontological point of view. We find repeated in Annelids the same striking coincidence between certain features only embryonic in the present types, and characters of the adults in past geological times. I was particularly struck with this coincidence when examining a series of drawings of fossil Annelids kindly shown me by Mr. O. C. Marsh, of New Haven, which were all provided with bunches or single bristles of these large, rough setæ, entirely out of proportion to the width of the body, and similar to those found in the embryonic Annelids we have noticed. The nature of the setæ and bristles, and their order of appearance in the types we have thus far examined, seem the only characters capable of general application of any systematic value; when a greater number of Annelids have been studied, the dorsal cirri, as well as the characters of the tentacles of the anterior part of the body, will furnish us with valuable additional guides for classification in relation to the rank of families and genera; and, as far as we can make use of them, they seem to coincide remarkably with the generally received notions of superiority and inferiority of the principal families current among the most accurate investigators of Annelids.

EXPLANATION OF PLATES V. & VI.

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|-------------------------------------|---|
| <i>v</i> , anterior vibratile ring. | <i>t</i> , tentacles. |
| <i>v'</i> , anal vibratile ring. | <i>y</i> , concretion capsules. |
| <i>m</i> , mouth. | <i>a</i> , anus. |
| <i>e</i> , eye-specks. | <i>r₅</i> , fifth ring in <i>Polydora</i> . |
| <i>o</i> , oesophagus. | <i>r</i> , first ring; the rings are counted from here. |
| <i>s</i> , stomach. | <i>g</i> , glands of <i>Polydora</i> . |
| <i>c</i> , intestine. | |

PLATE V.

- Fig. 1.* Young *Planaria angulata*, with distinct articulations, seen from above.
- Fig. 2.* Somewhat older than fig. 1; both figures greatly magnified.
- Fig. 3.* Youngest stage of *Nareda* observed; seen in profile.
- Fig. 4.* Somewhat more advanced than fig. 3; the pigment-spots have increased in number, the tentacles of the head are making their appearance: seen in profile.
- Fig. 5.* Older stage, in which the difference in width between the anterior disk and the body has attained its maximum; large increase in number of pigment-spots, diminution in diameter of digestive cavity: seen in profile.
- Fig. 6.* Posterior extremity of young *Nareda*, about in the condition of fig. 5, showing the intestine and place of formation of new rings; seen in profile.
- Fig. 7.* Stage in which the anterior disk is diminishing in size and becoming slightly elongated; seen from the dorsal side.
- Fig. 8.* Head of *Nareda* in stage of fig. 7: seen from the mouth side.
- Fig. 9.* Older stage than fig. 8; the rings are further apart, the pigment-spots larger; the head has become greatly elongated, and the tentacles are more prominent: seen from the dorsal side.
- Fig. 10.* Older than fig. 9; the pigment-spots have become quite small, and the vibratile rings are much reduced: seen from the dorsal side.
- Fig. 11.* Somewhat more advanced than fig. 10; the anterior disk has lost its prominence, the vibratile cilia have nearly disappeared, the stomach has become convoluted, the pigment-spots are scarcely perceptible, and the articulations quite indistinct: seen in profile: very sluggish in its movements; about one-fourth of an inch long.
- Fig. 12.* Head of specimen slightly older than fig. 11; seen in profile.
- Fig. 13.* The same, seen from the dorsal side; the tentacles are contracting.
- Fig. 14.* Young *Nareda* which has lost almost all trace of the tentacles of the head, about half an inch long.
- Fig. 15.* Head of a somewhat older specimen.
- Fig. 16.* The same as fig. 15; seen in profile.
- Fig. 17.* The head of a *Nareda* which has become less wide than the body; about five months older than fig. 4.
- Fig. 18.* Portion of string of eggs of *Spirorbis*.
- Fig. 19.* Young *Terebella fulgida*, Ag., showing the order of development of the tentacles, *t₁*, *t₃*, and the concretionary lime capsules, *y*; greatly magnified.
- Fig. 19^a.* Stiff bristles of the rings; magnified.

- Fig. 20. Young *Spirorbis* soon after its escape from the egg, having only one tentacle developed, on the right, t_1 .
- Fig. 21. Somewhat more advanced than the preceding figure, showing the first trace of opercular tentacle.
- Fig. 22. Young *Spirorbis*, having three pairs of bristles; somewhat older than the preceding stage.
- Fig. 23. The anterior extremity of a specimen more advanced than fig. 22, showing the first trace of bifurcation of the tentacles.
- Fig. 24. Anterior extremity of a still older specimen, in which the contrast between the opercular tentacle (t_0) and the others (t_1-t_4) becomes very marked.
- Fig. 25. Young *Spirorbis*, in which all the characters of the adult can be readily recognized. Lettering as above.
- Fig. 26. Young *Polydora* having already lost the temporary bristles of the anterior rings.
- Fig. 27. Somewhat older than the preceding figure; the pigment-spots of the anterior part are more marked: from below.
- Fig. 28. Older than fig. 27; the dorsal cirri are quite apparent.
- Fig. 29. Young *Polydora*, seen from below; the pigment-cells are more concentrated than in the preceding stages.
- Fig. 30. Somewhat more advanced: seen from the dorsal side: the pigment-spots are reduced to mere dots; the number of rings has not increased from the preceding stage.

PLATE VI.

- Fig. 31. Head of *Polydora* having forty rings.
- Fig. 32. Anterior of young *Polydora* not quite full-grown; from below.
- Fig. 33. Adult *Polydora*, seen from above.
- Fig. 34. Profile view of anal extremity of *Polydora*.
- Fig. 35. Profile view of the anterior extremity of *Polydora*.
- Fig. 36. Gland found at the side of each of the rings beyond the sixth, at the base of the dorsal cirrus.
- Fig. 37. Stiff bristles of the fifth ring.
- Fig. 38. Small hook-shaped bristle of rings following the fifth.
- Fig. 39. Young *Nerine* provided with the temporary bunch of bristles.
- Fig. 40. *Nerine* in which the tentacles and dorsal cirri have begun to develop, which has lost the large bunch of serrated bristles.
- Fig. 41. Somewhat more advanced than fig. 40.
- Fig. 42. Young *Nerine*, having most of the characters of the adult.
- Fig. 42^a. Portion of one of the serrated bristles of the temporary cluster of fig. 39.
- Fig. 43. Anterior extremity of an adult *Nerine*, seen in profile.
- Fig. 44. Hook-shaped stiff bristles of the lower side.
- Fig. 45. Posterior extremity of *Nerine*.
- Fig. 46. Young *Phyllodoce*, from the dorsal side.
- Fig. 47 (upper fig.). Fig. 46 seen in profile.
- Fig. 47 (lower fig.). The tentacles of the anterior part of the *Phyllodoce* have developed; the body has considerably lengthened; seen from the dorsal side.
- Fig. 49. The same, seen from the mouth side.
- Fig. 50. Young *Phyllodoce*, seen in profile in stage of fig. 47 (lower fig.).
- Fig. 51. Somewhat older than the preceding stages; seen from above.
- Fig. 52. Young *Phyllodoce* in which the body has greatly elongated; seen from above.
- Fig. 53. Head of adult *Phyllodoce maculata*, from above.
- Fig. 54. Paddle and setæ of adult of fig. 53; seen in profile.

Fig. 55. Anal extremity of the same.

Fig. 56. Embryo Annelid, with immense bunches of temporary bristles.

Fig. 57. Adult of fig. 56?

Fig. 58. Minute Annelid parasitic on shell of lobster.

XXXVIII.—*Description of a new Species of Mesoprion.*

By Dr. ALBERT GÜNTHER.

[Plate IX.]

THE finest specimens of stuffed fishes which I have seen are prepared by the native employés of the Madras Museum. Capt. Mitchell, curator of this museum, has sent a small collection of such examples to the coming Universal Exhibition at Paris. Among them I have observed a new and very aberrant species of *Mesoprion*, distinguished by very feeble jaws and canine teeth, a very narrow præorbital, short snout, &c. I propose to name it

Mesoprion Mitchelli. Pl. IX.

D. $\frac{11}{13}$. A. $\frac{3}{9}$. L. lat. 70. L. transv. 10/22.

The height of the body is one-third of the total length (to the end of the middle caudal rays), the length of the head two-ninths. The snout is but little longer than the eye, which is nearly one-fourth of the length of the head. Jaws feeble, the lower projecting beyond the upper; the maxillary scarcely extends beyond the front margin of the orbit. Teeth in the jaws, vomer, and palatines villiform, in very narrow bands; the upper jaw only is armed with a pair of minute canines. Præorbital very narrow, its width being about half that of the orbit. Scales on the cheek in four or five series, the naked portion of the præoperculum being very broad at the angle. Præoperculum very finely serrated behind, the angle being radiated, each radius terminating in a scarcely perceptible spine. Basal half or third of the vertical fins densely covered with scales. Dorsal fin with the upper margin even; spines slender; the first is one-third as long as the second, which is not much shorter than the fourth and fifth, which are the longest and half as long as the head. The second and third anal spines are feeble, equal in length, and shorter than the second of the dorsal. Caudal fin emarginate. Pectoral falciform, longer than the head, not extending to the vent. Dark oblique and longitudinal lines run along the series of scales. Vertical fins with a narrow blackish edge.

The specimen is 16 inches long; it has been kindly promised for the Collection of the British Museum, after the close of the Paris Exhibition.